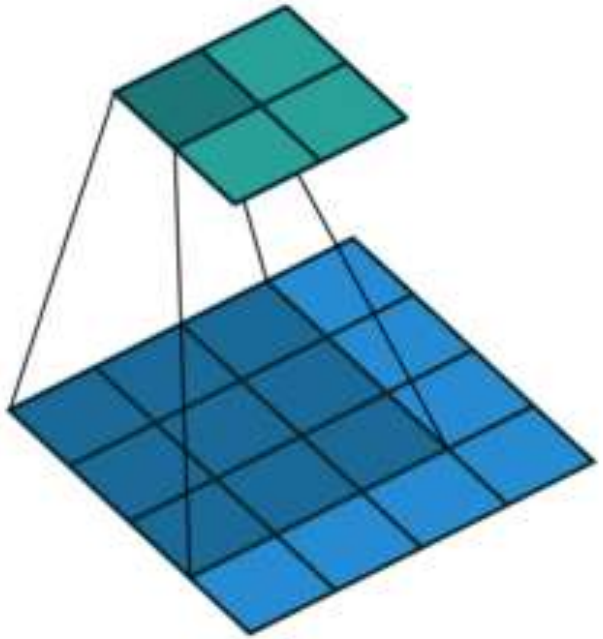
CONVOLUTIONAL NEURAL NETWORKS



Informationsverarbeitung II:
Informationsextraktion mit Neuronalen Netzwerken
Eduard Saller

Overview

- History
- CNN Topology Overview
- Example with step by step introduction of important terms
- CNNs for NLP
- Discussion

History

- Yann LeCun

New York University

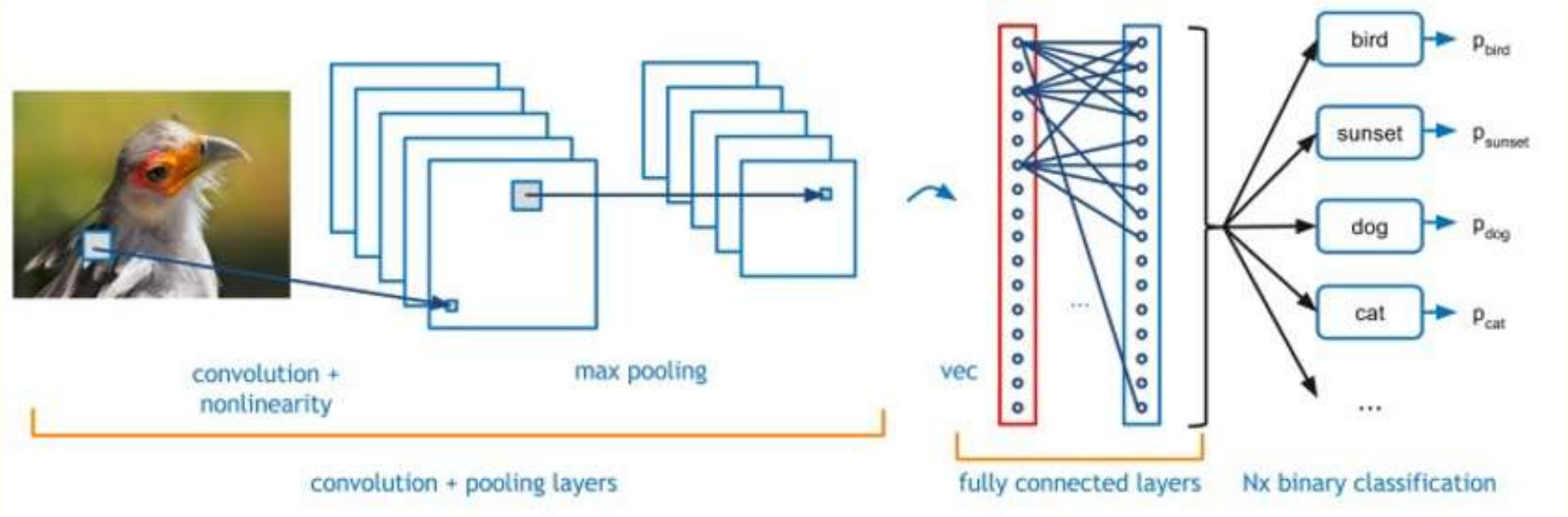
Facebook Artificial Intelligence Research

- Yoshua Bengio

Université de Montréal

- In 1995, Yann LeCun and Yoshua Bengio introduced the concept of convolutional neural networks.

CNN Topology



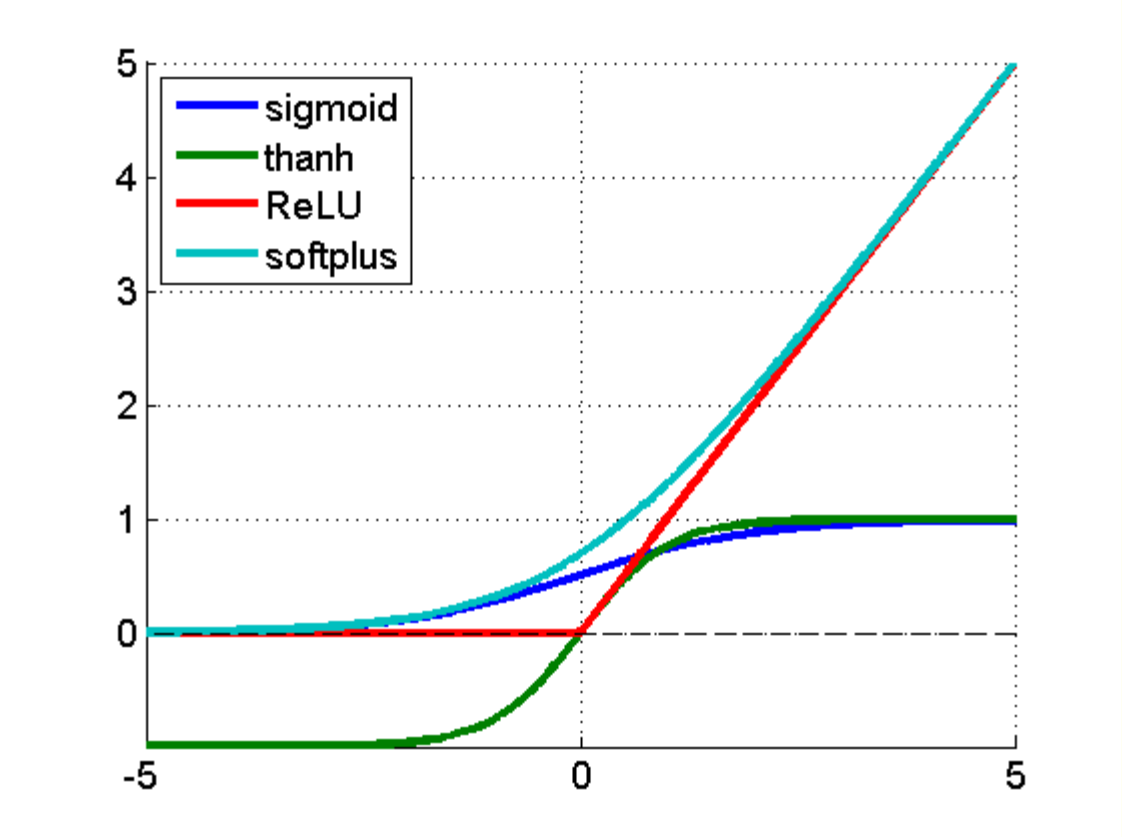
http://www.nallatech.com/fpga-acceleration-convolutional-neural-networks/

Recap: Non-Linearity?

- A neural network is only non-linear if you squash the output signal from the nodes with a non-linear activation function.

  => arbitrary function approximator

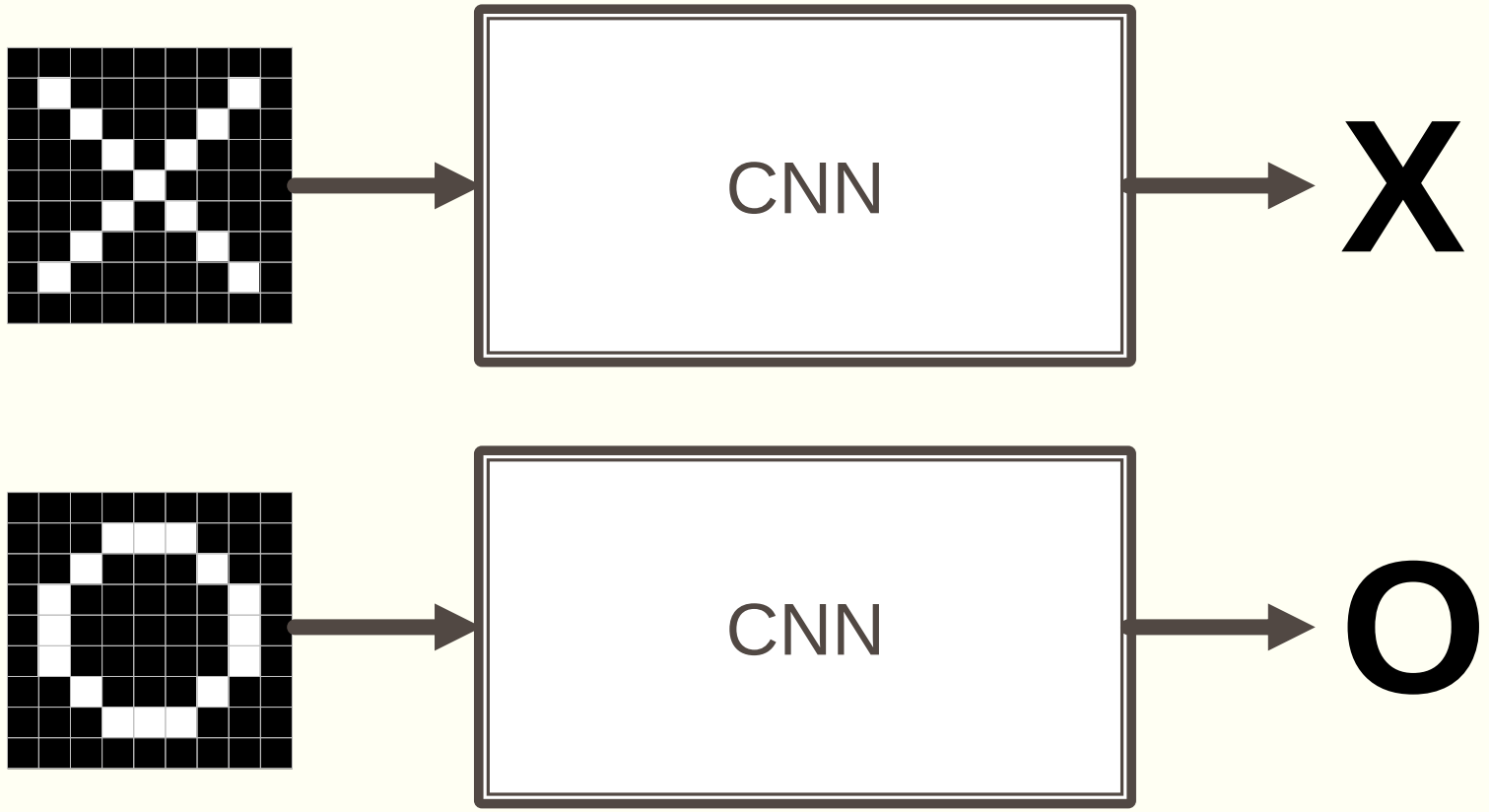
- Interpreting the squashed output signal could very well be interpreted as the strength of this signal (biologically speaking)



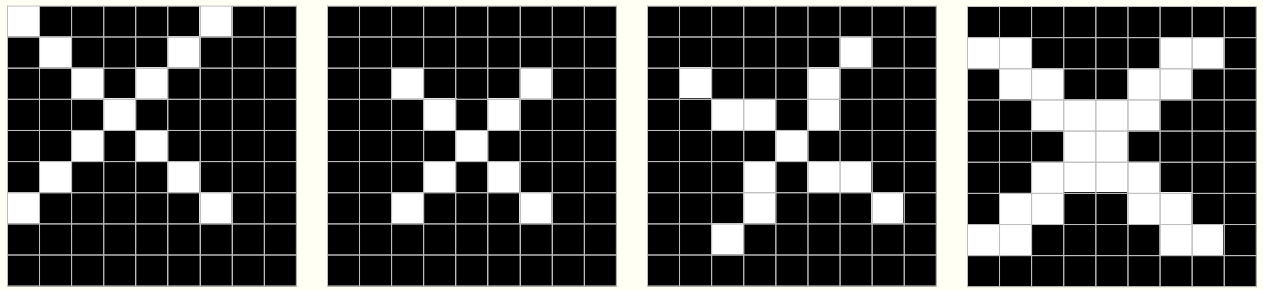
Toy Example

A two-dimensional array of pixels

Toy Example



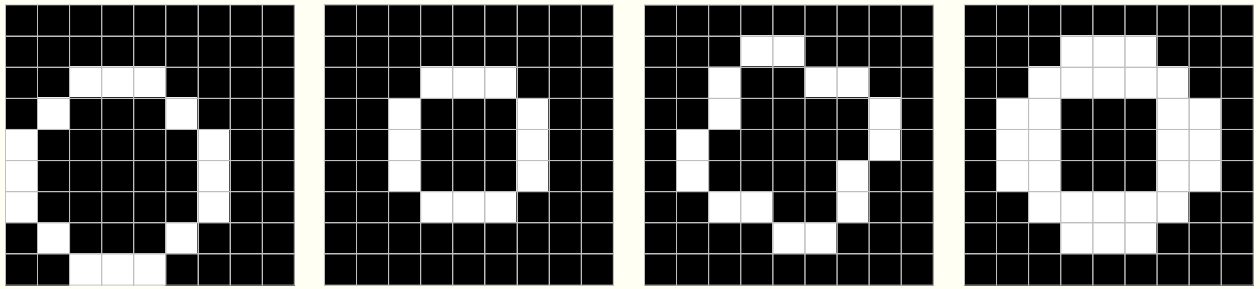
Harder to solve problem



translation scaling rotation weight

CNN

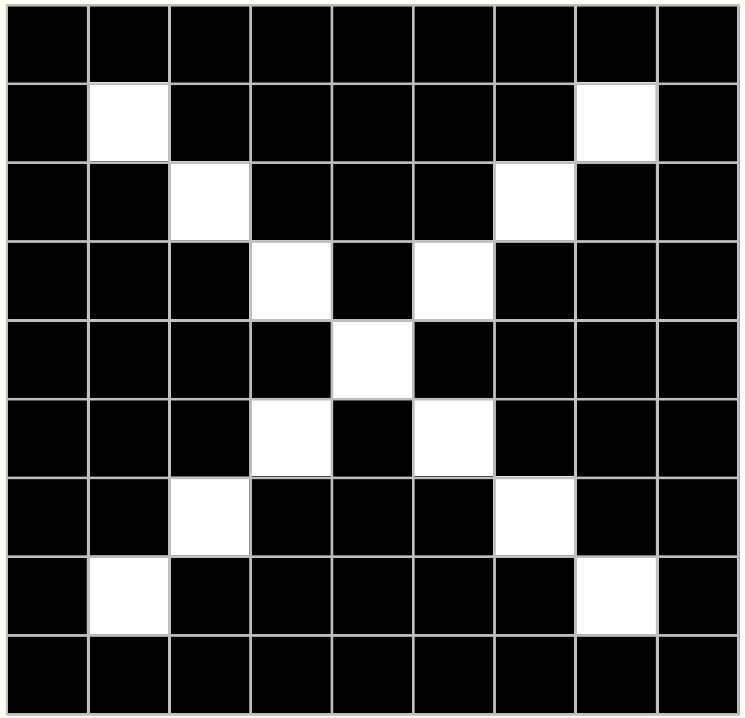
X

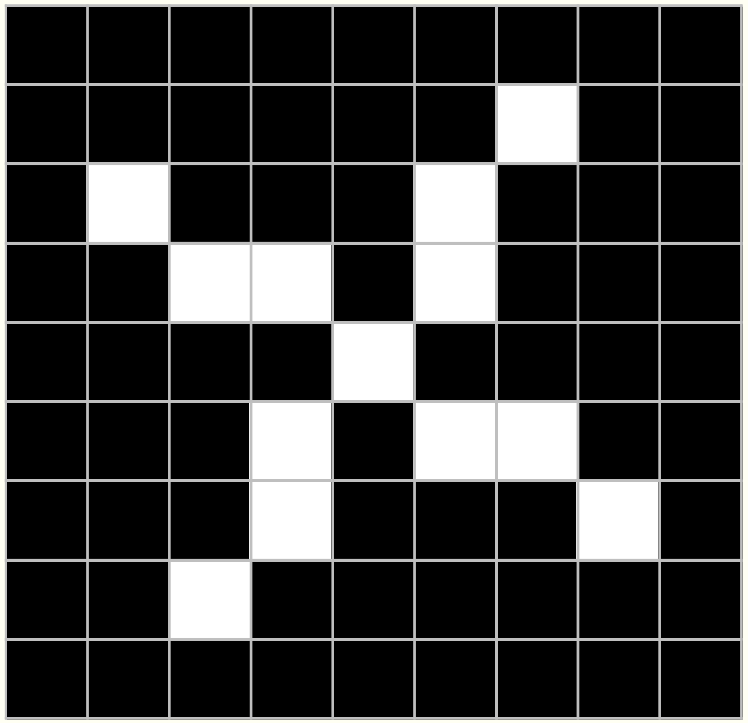


CNN

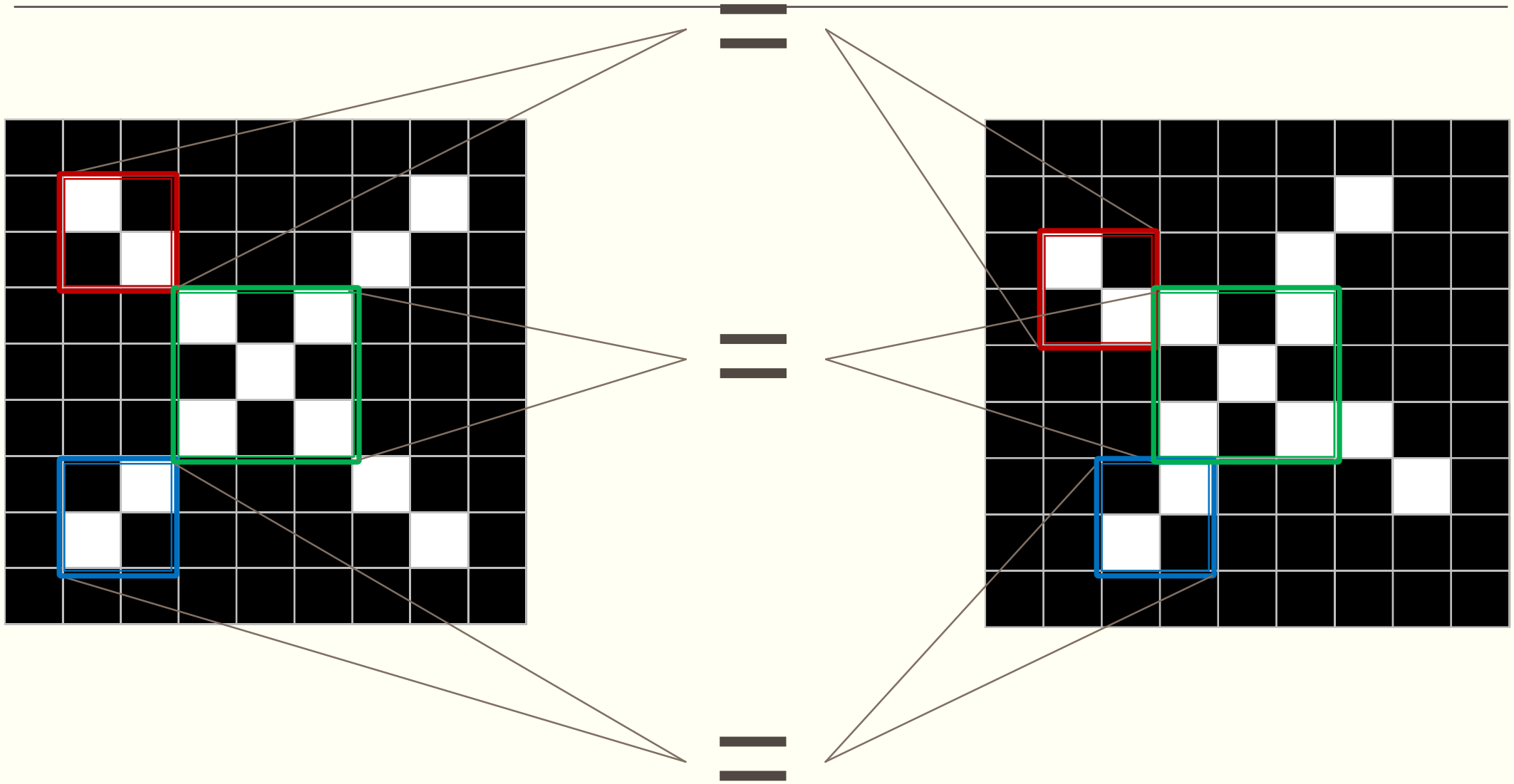
O

How to compare?

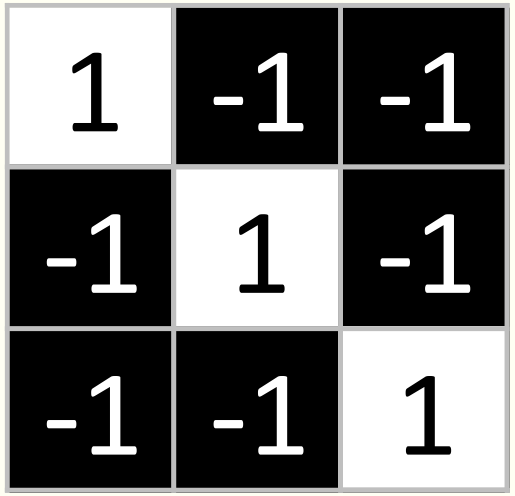


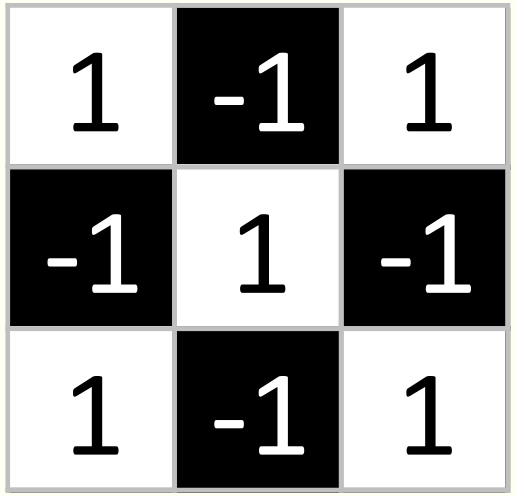


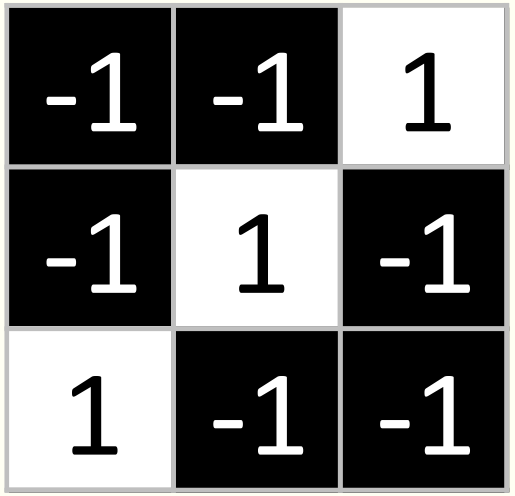
Compare smaller areas



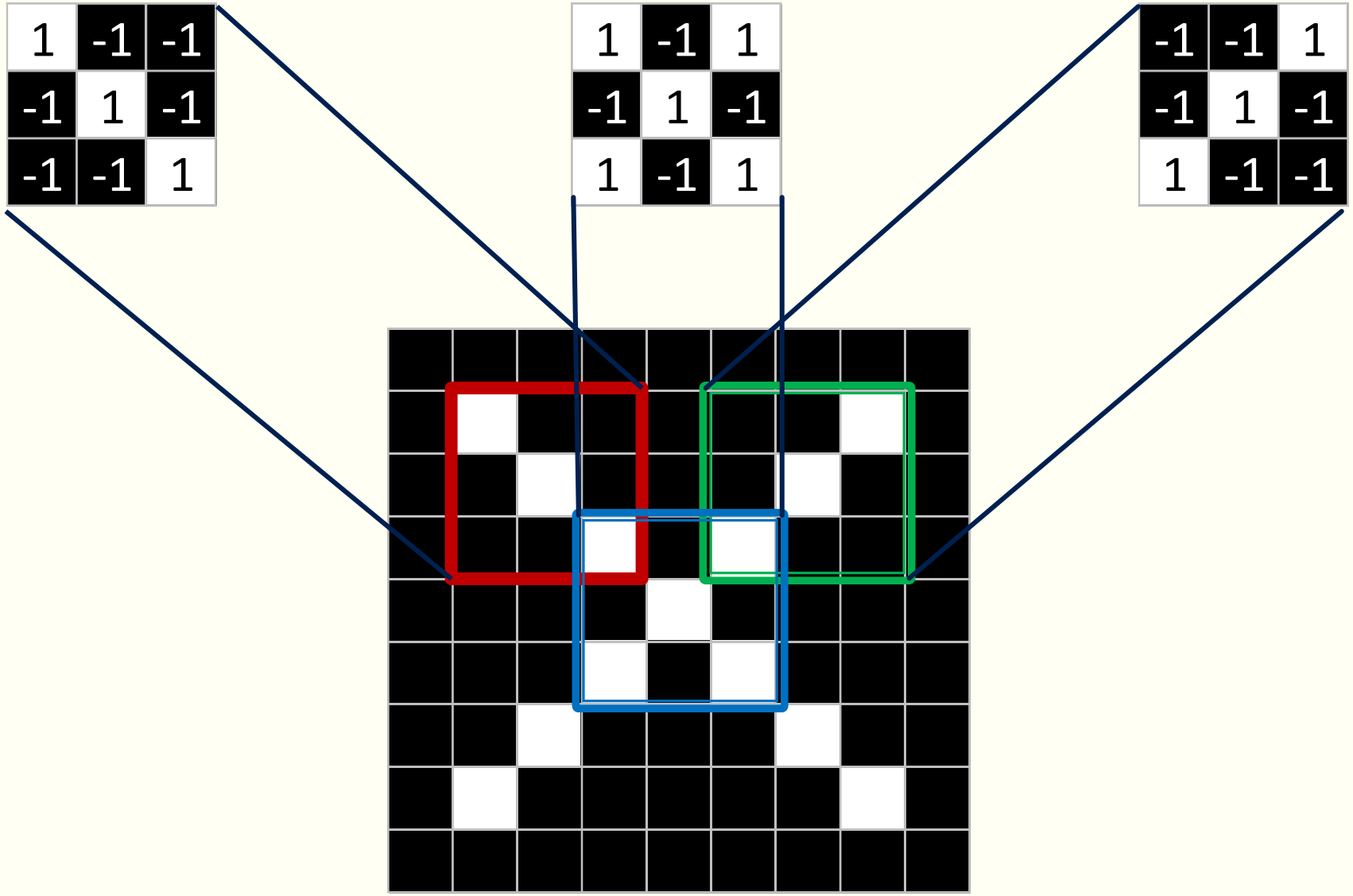
Term: Filter



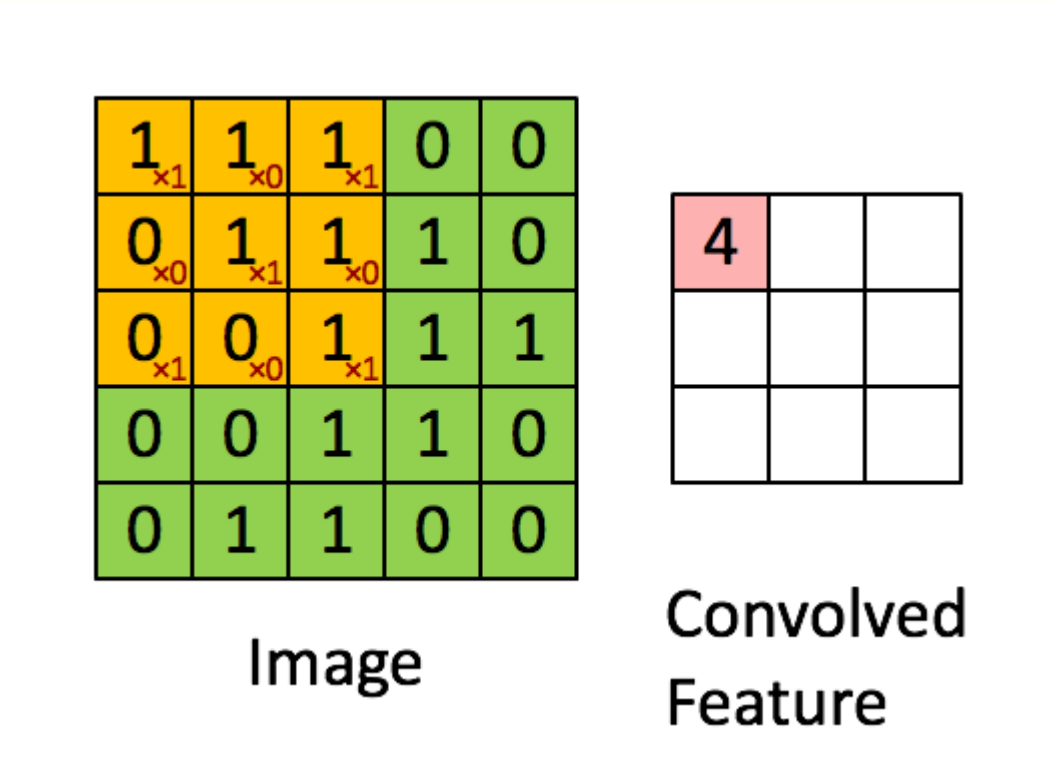




Term: Filter



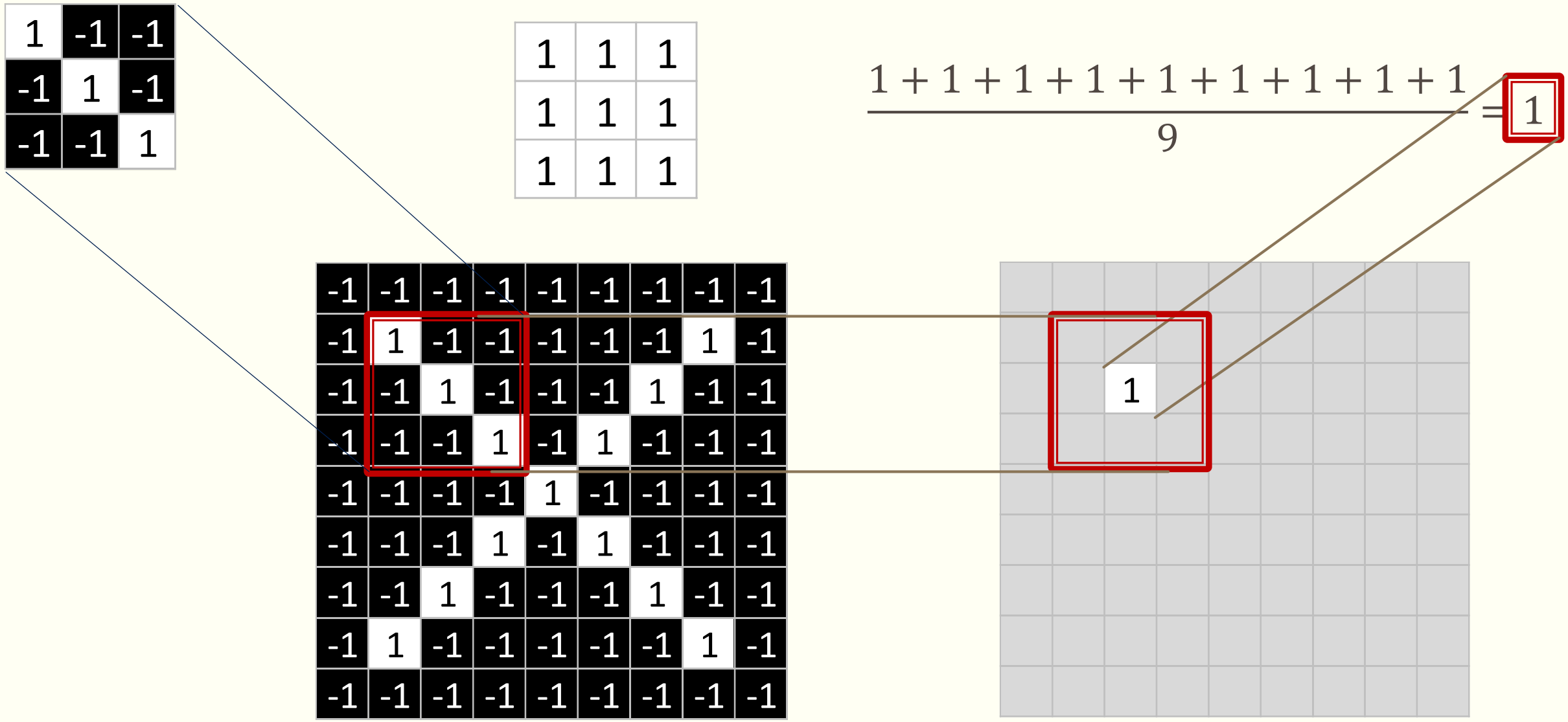
Term: Convolution

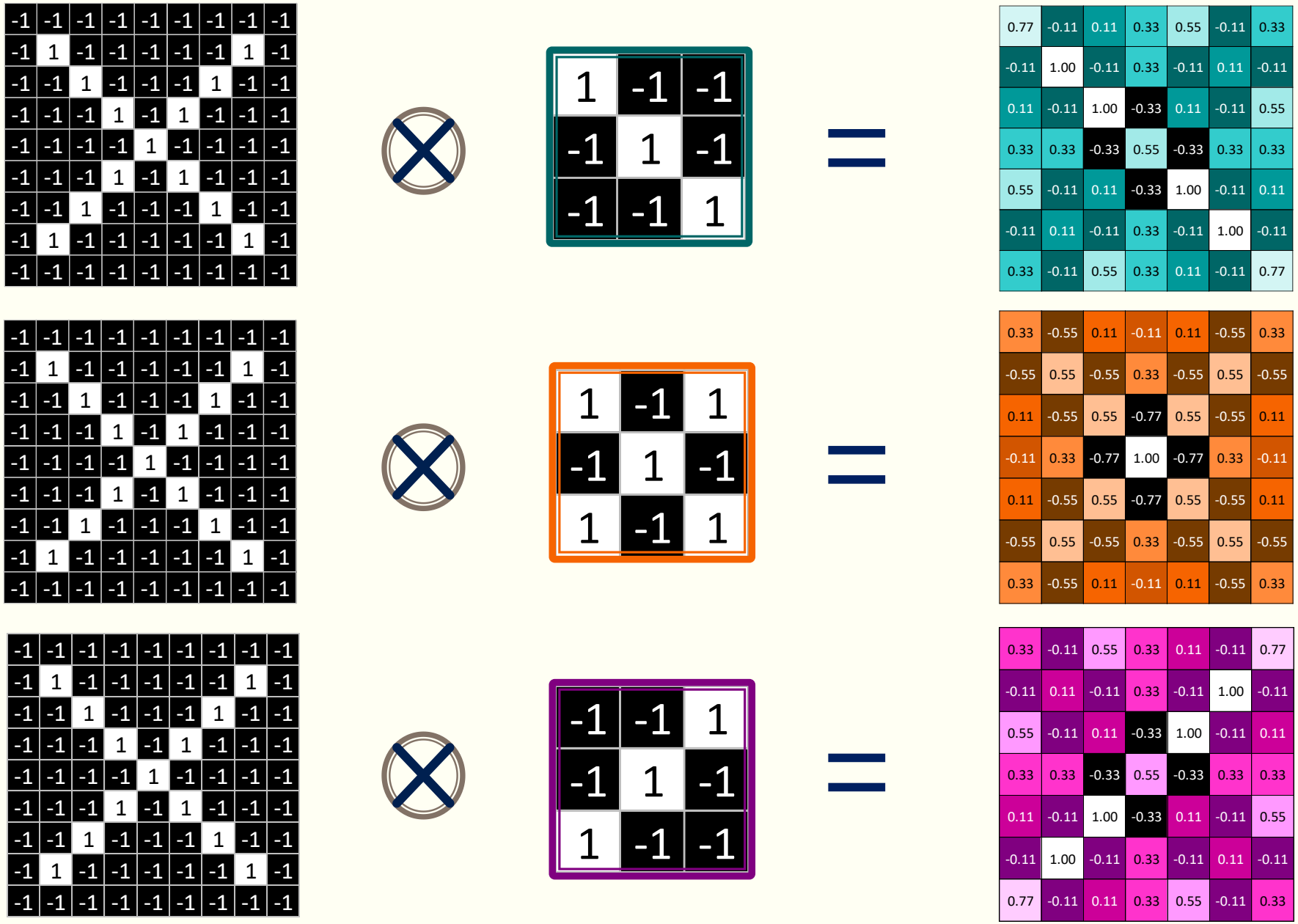


Used fitlers to create a **filter layer** based on the input
- Yellow area: counts all ones that are part of ist diagonal
- Green area: input features

http://deeplearning.stanford.edu/wiki/index.php/Feature_extraction_using_convolution

Building the filter layer

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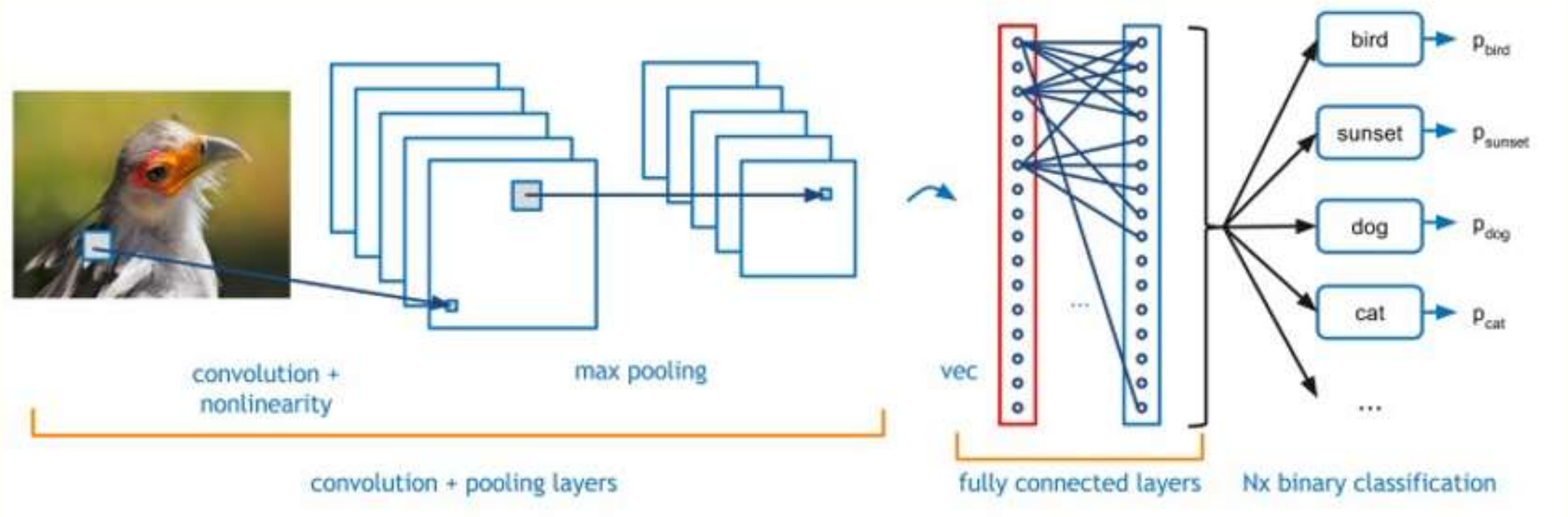
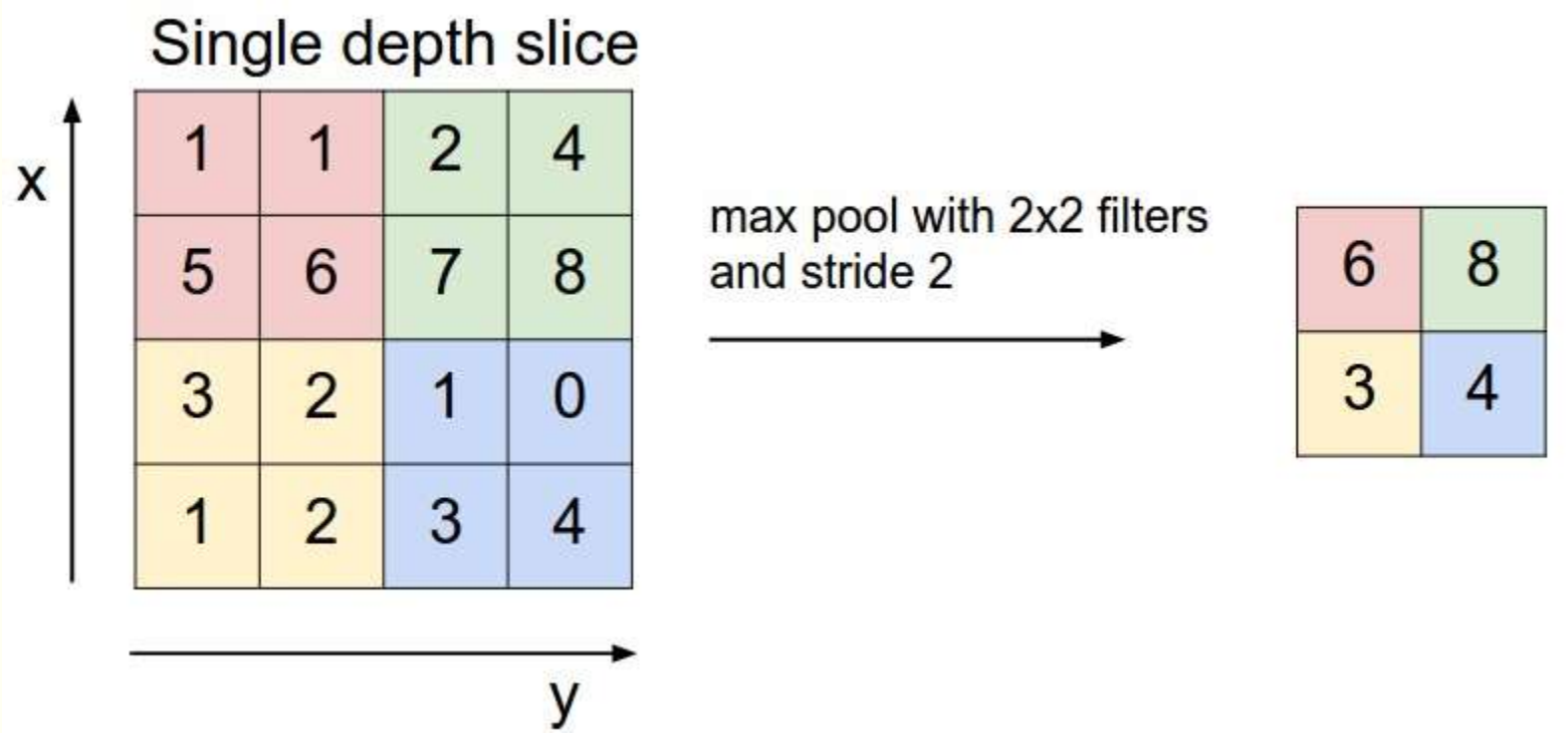
0.77 -0.11 0.11 0.33 0.55 -0.11 0.33

Recap: CNN Topology

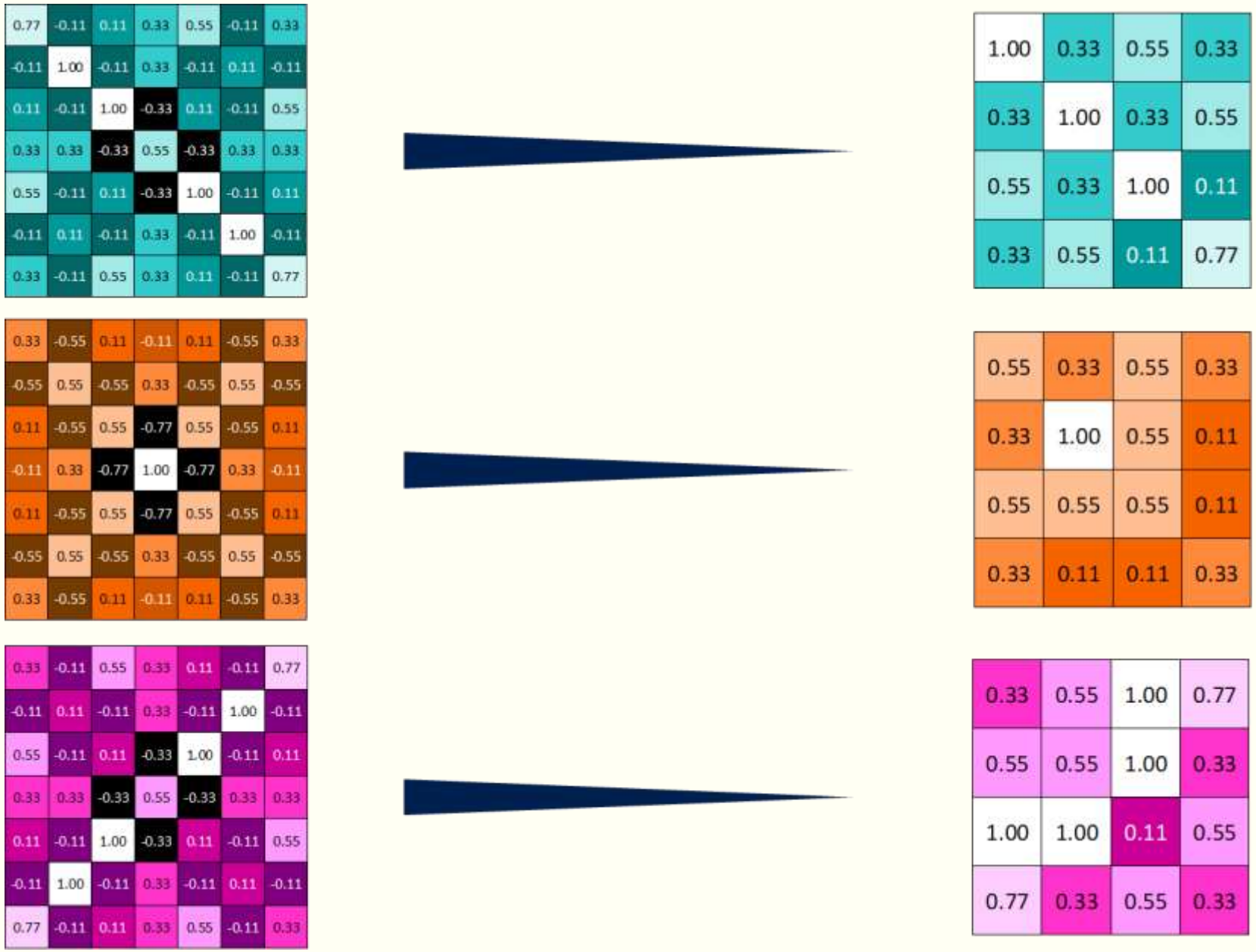


http://www.nallatech.com/fpga-acceleration-convolutional-neural-networks/

Term: Pooling Layers



http://cs231n.github.io/convolutional-networks/#pool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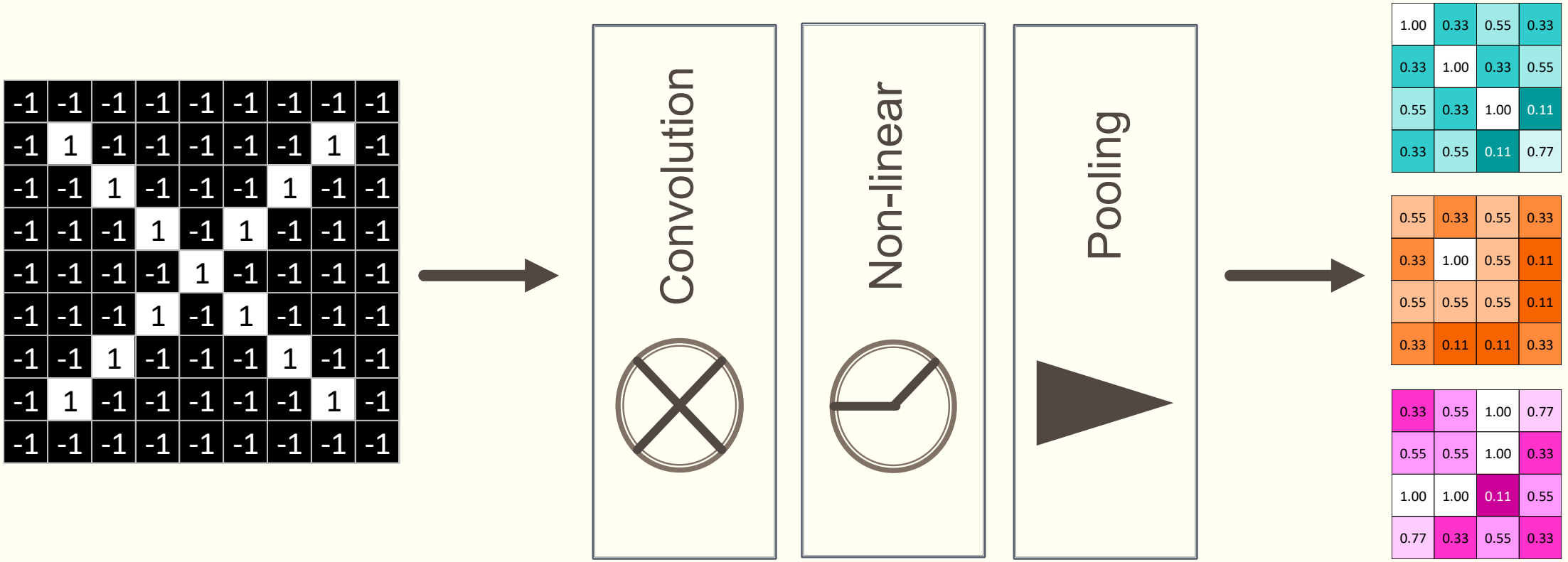
Stacking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-1 -1 1 -1 -1 -1 1 -1 -1
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-1 -1 -1 -1 -1 -1 -1 -1 -1
Convolution
Non-linear
Pooling
1.00 0.33 0.55 0.33
0.33 1.00 0.33 0.55
0.55 0.33 1.00 0.11
0.33 0.55 0.11 0.77
0.55 0.33 0.55 0.33
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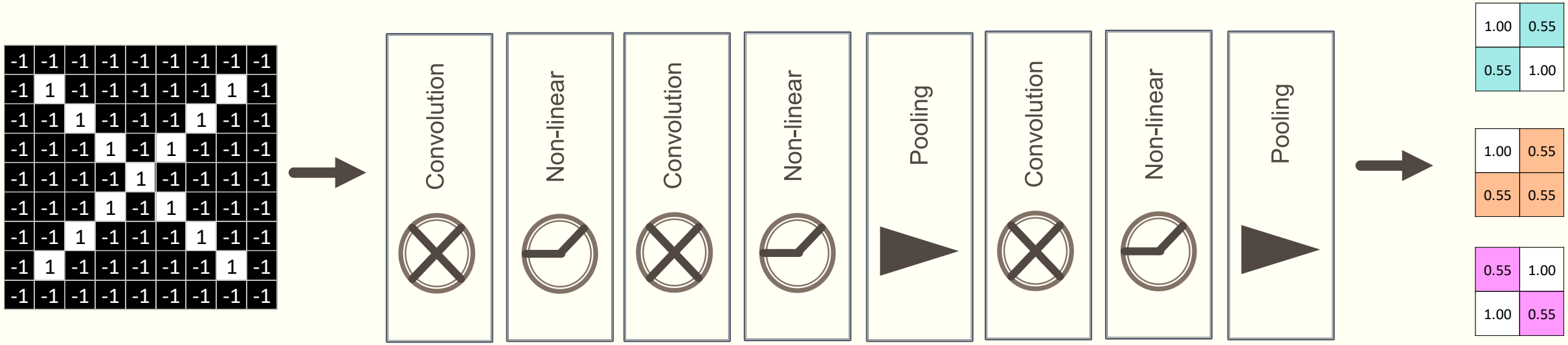
0.55 0.55 0.55 0.11
0.33 0.11 0.11 0.33
0.33 0.55 1.00 0.77
0.55 0.55 1.00 0.33
1.00 1.00 0.11 0.55
0.77 0.33 0.55 0.33

Stacking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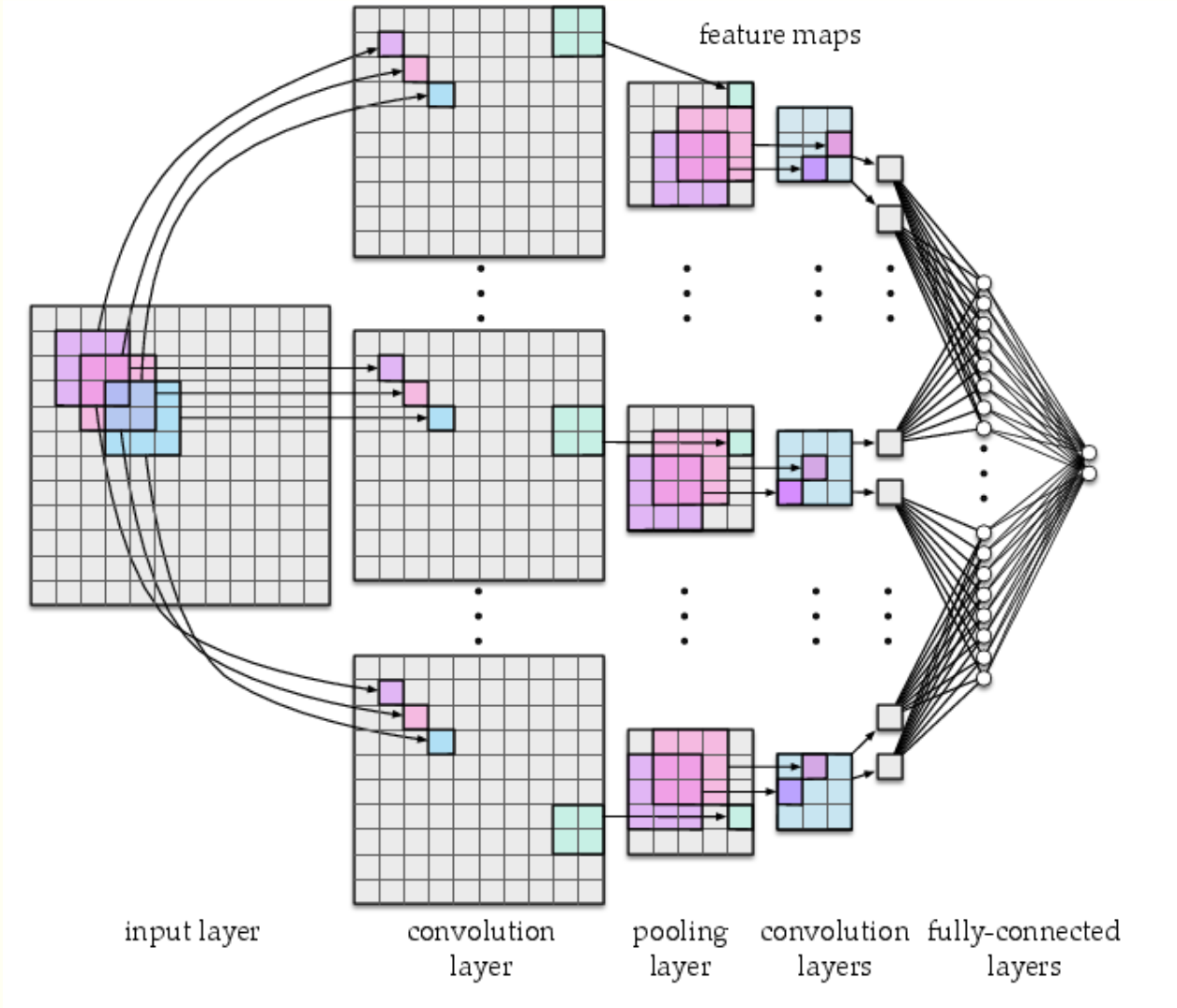
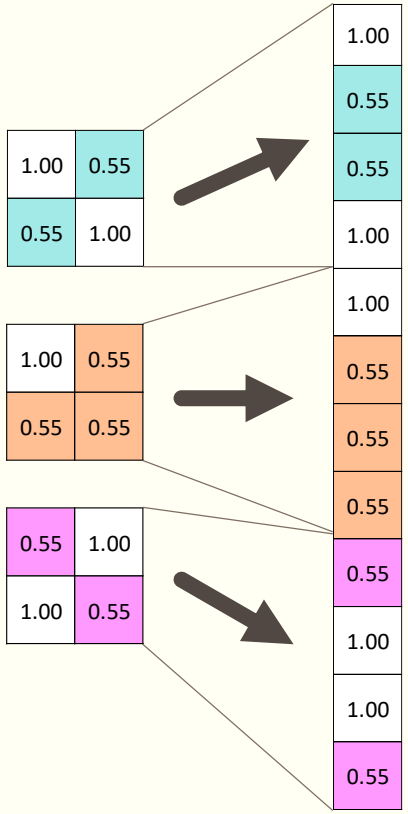
-1 -1 1 -1 -1 -1 1 -1 -1
-1 1 -1 -1 -1 -1 -1 1 -1
-1 -1 -1 -1 -1 -1 -1 -1 -1
Convolution
Non-linear
Convolution
Non-linear
Pooling
Convolution
Non-linear
Pooling
1.00 0.55
0.55 1.00
1.00 0.55
0.55 0.55
0.55 1.00
1.00 0.55

Term: fully-connected layer

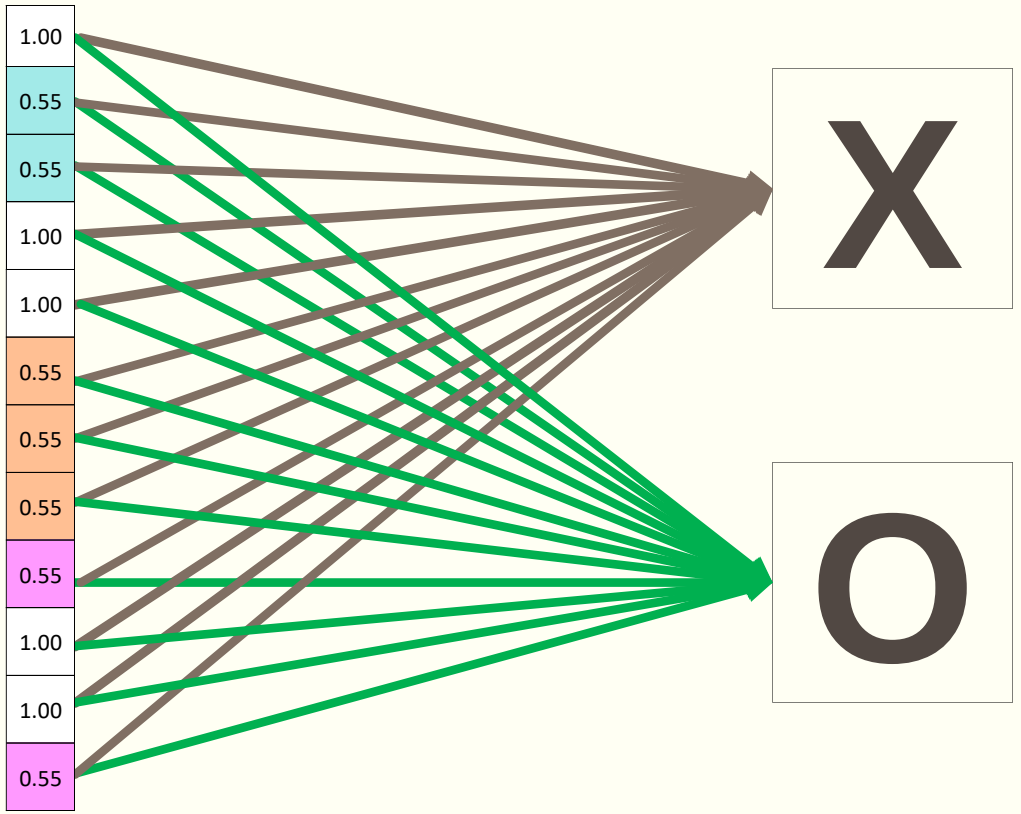
- takes an input volume and outputs an N dimensional vector



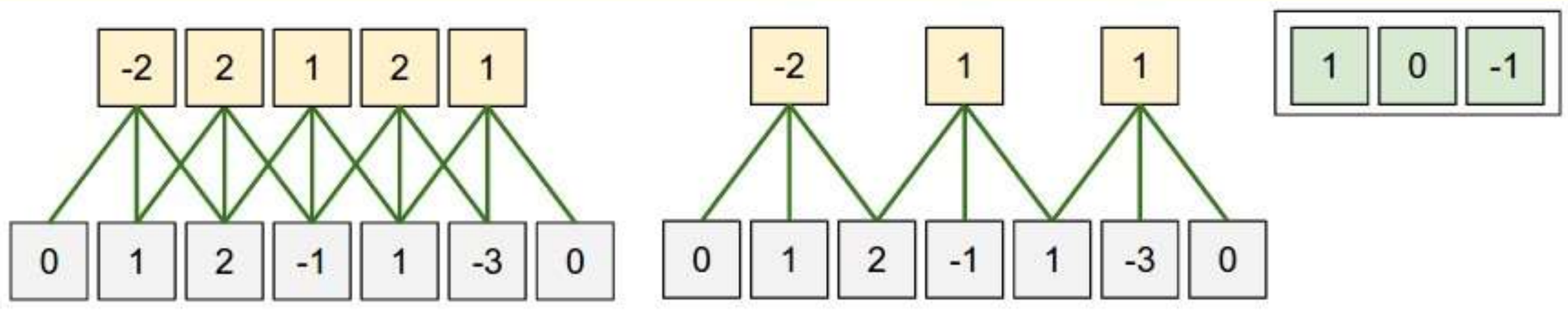
Toy example: fully-connected layer



fully-connected layer => Voting on an answer

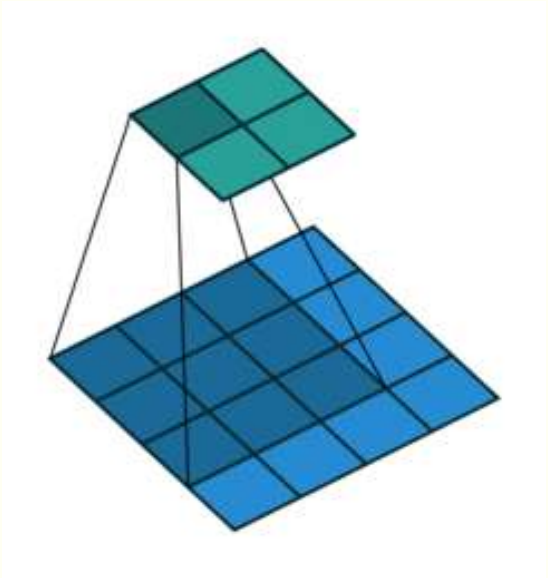


Term: Strides

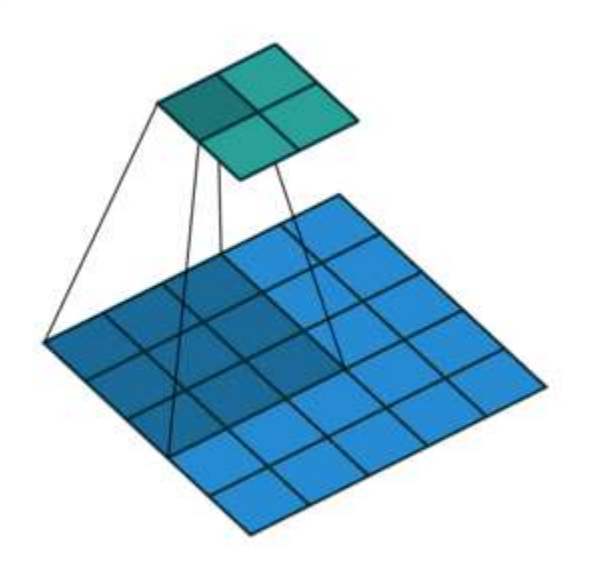


http://cs231n.github.io/convolutional-networks/

Term: Strides

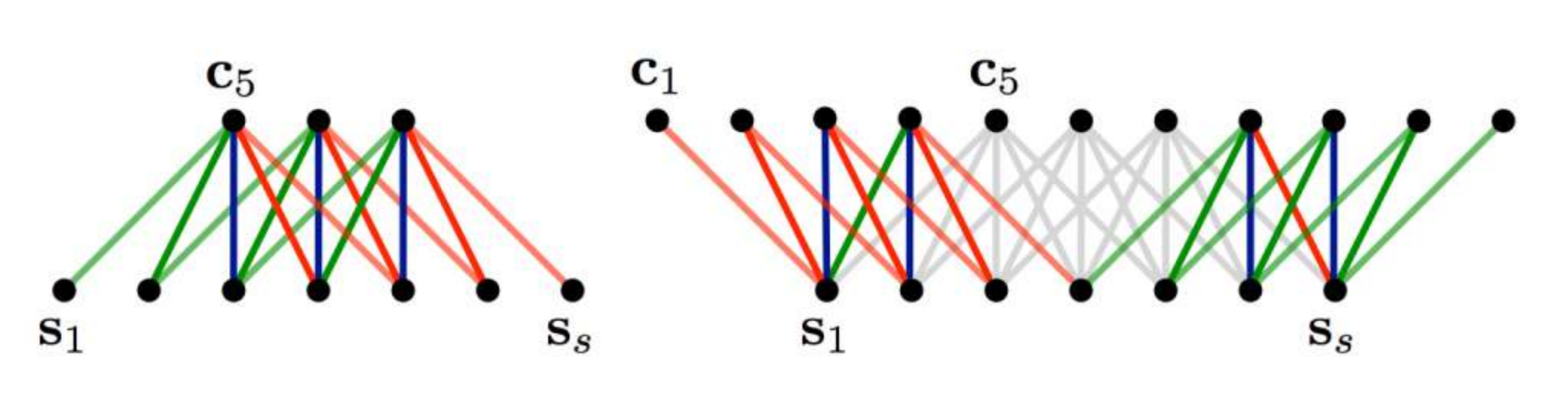


without strides



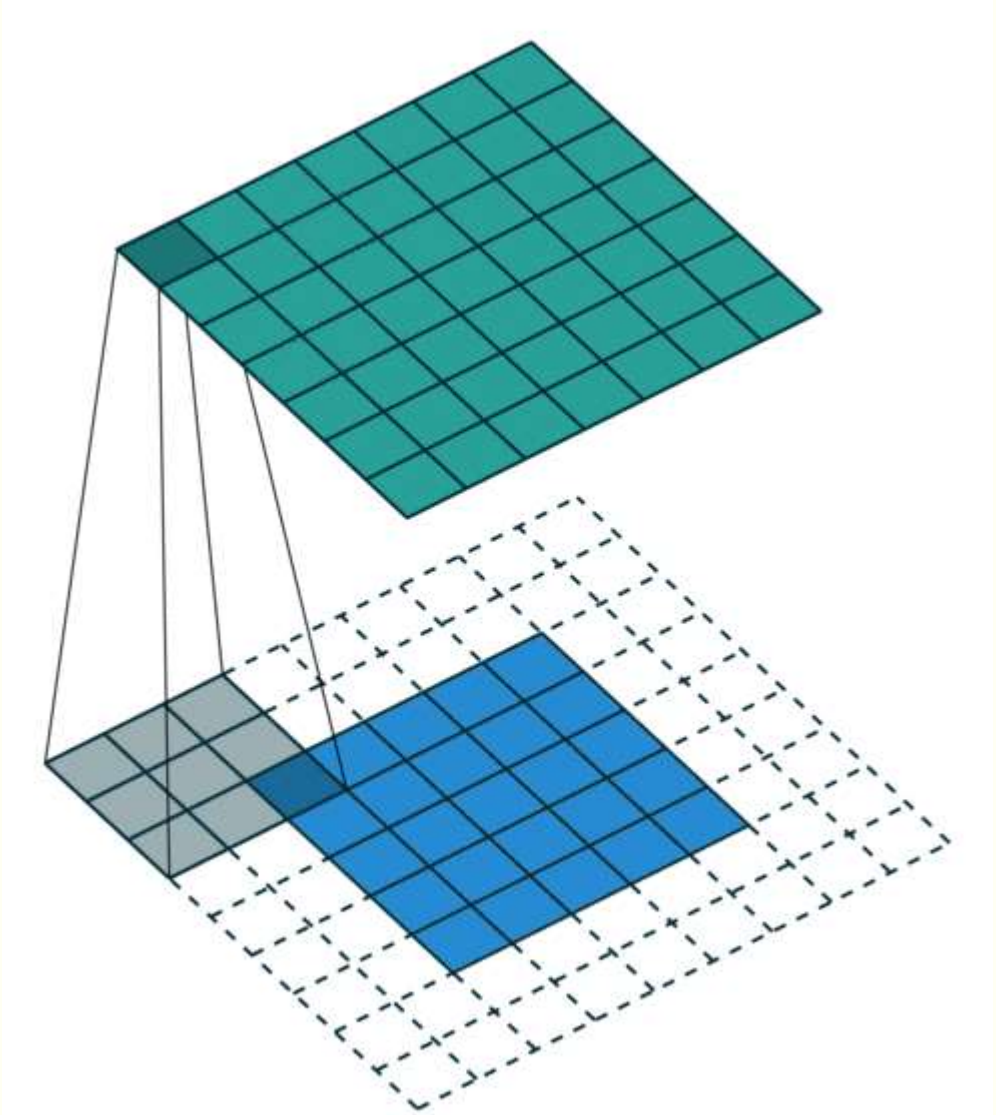
with strides

Term: Padding



A Convolutional Neural Network for Modelling Sentences (2014)

Term: Padding

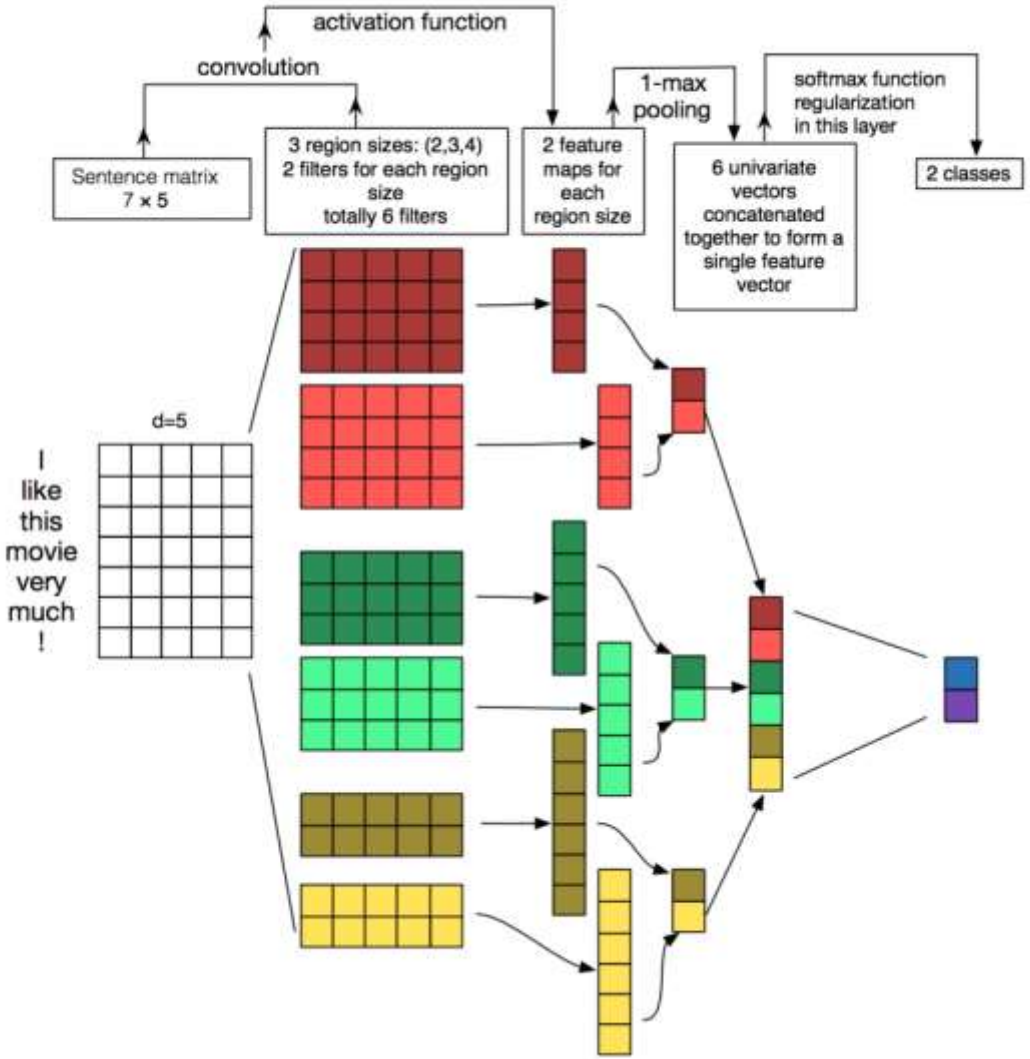


NLP: What area would be good fits

classifications tasks, such as:

- Sentiment Analysis
- Spam Detection
- Topic Categorization

NLP



Source: Zhang, Y., & Wallace, B. (2015). A Sensitivity Analysis of (and Practitioners' Guide to) Convolutional Neural Networks for Sentence Classification

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